CLAIMS

We claim:

1. A method for determining the 3-D configuration of obscured portions of a structure in motion comprising:

    employing a source of electromagnetic energy to project electromagnetic energy;

    employing a device to modulate said projected electromagnetic energy;

    establishing contrasting portions of electromagnetic energy on said structure by utilizing projections from said source of electromagnetic energy as modulated by said device;

    providing a collector positioned off-axis from said source;

    moving said obscured portions of structure adjacent said at least one device in one direction at a time,

    wherein, as seen by said collector, said projecting of said directed electromagnetic energy results in at least one distorted portion of reflections of said directed electromagnetic energy from said structure wherever said structure has a vertical component perpendicular to the plane parallel to the direction of movement of said structure;

    using said at least one off-axis collector to collect, at a pre-specified sampling rate, said reflections from said structure;

    providing at least one pre-specified algorithm; and

    using said at least one pre-specified algorithm, processing said reflections, wherein said processing yields at least one three dimensional representation of said obscured structure.

2. The method of claim 1 employing said source operating at a wavelength selected from the group consisting of: visible electromagnetic waves of a single frequency, visible electromagnetic waves operating at multiple frequencies, invisible electromagnetic waves of a single frequency, invisible electromagnetic waves operating at multiple frequencies, and any combination thereof.

3. The method of claim 2 employing wavelengths selected from the group consisting of: broadband visible light, broadband invisible light, non-coherent x-rays, broadband ultraviolet light, broadband infrared light, non-coherent radar waves, non-coherent radio waves, and combinations thereof.

4. The method of claim 2 employing wavelength is selected from the group consisting of: coherent visible light, coherent invisible light, coherent x-rays, coherent ultraviolet light, coherent infrared light, coherent radar waves, coherent radio waves, and combinations thereof.

5. The method of claim 1 employing contrasting portions comprise at least one set of images on said structure, said set having a first image of an illumination band and a second image of a non-illumination band,
wherein said illumination band and said non-illumination band are parallel and multiple said sets are parallel one to the other said sets.

6. The method of claim 1 employing a camera as said at least one off-axis collector.

7. The method of claim 1 employing a digital camera as said at least one off-axis collector.

8. The method of claim 1 employing processing further comprising:
converting any said collected reflections that are analog to digital format;
performing a Fast Fourier Transform (FFT) of said collected reflections, as provided in digital format, to yield FFT data;
filtering said FFT data about the fundamental spectral frequency of said modulated electromagnetic energy in the direction transverse to the direction of movement of said structure; and
employing said at least one complex algorithm to extract at least one change in phase of said modulated electromagnetic energy.

9. The method of claim 8 wherein said change in phase is related to changes in said vertical component of the dimension of said structure, *z*, by the relationship:

$$z(x,y) = \frac{L \cdot \Delta\theta}{\Delta\theta - 2\pi \cdot f \cdot d}$$

where:

$\Delta\theta$	=	change in phase
f	=	instantaneous frequency with respect to distance of said electromagnetic energy
d	=	interplanar distance between said collector and said device where each are located in the same plane
L	=	distance between said collector and an arbitrary reference surface

wherein after processing a single frame of said reflections, an ordered triplet *(x, y, z)* is established for concurrent use or archives, and wherein multiple said ordered triplets may be used or displayed concurrently with employment of said method.

10. A system for determining the 3-D configuration of obscured portions of structure in motion, comprising:

at least one device for modulating electromagnetic energy in a pre-specified form,

wherein said structure is moved adjacent said at least one device while maintaining physical separation therefrom, and

wherein said device enhances the contrast of said electromagnetic energy impinging on said structure;

at least one collector for acquiring, at a pre-specified sampling rate, electromagnetic energy reflected from said structure and providing said acquired electromagnetic energy as output, and

at least one processor, having an input and an output, in operable communication with said at least one collector for manipulating said output of said at least one collector.

11. The system of claim 10 at least part of which is embedded in or below a surface over which said structure moves.

12. The system of claim 10 in which said at least one collector comprises at least one objective lens in operable communication with at least one imager remotely located from said at least one objective lens,
wherein said objective lens is embedded in or below said surface over which said structure moves.

13. The system of claim 12 in which said at least one imager is in operable communication with said at least one objective lens via a means selected from the group consisting of: coaxial cable, fiber optic cable, wireless transmissions, and combinations thereof.

14. The system of claim 10 in which said at least one processor provides an interface to at least one second system.

15. The system of claim 10 in which said at least at least one processor incorporates a control function for both collecting and processing said collected electromagnetic energy.

16. The system of claim 10 in which said at least one collector is at least one imager.

17. The system of claim 16 in which said at least one imager is a camera.

18. The system of claim 17 in which said camera is a digital camera.

19. The system of claim 10 further comprising a control separate from said at least one processor.

20. The system of claim 19 in which said control facilitates accessing and comparing data from a database with said output of said at least one processor, and storing, manipulating, and reporting said output of said at least one processor.

21. The system of claim 10 in which said second system implements a function selected from the group consisting essentially of: access control, configuration identification, security inspection, quality control, safety inspection, automated toll collection, commercial vehicle inspection, and combinations thereof.

22. The system of claim 10 in which said electromagnetic energy is provided at a wavelength selected from the group consisting of: visible electromagnetic waves of a single frequency, visible electromagnetic waves operating at multiple frequencies, invisible electromagnetic waves of a single frequency, invisible electromagnetic waves operating at multiple frequencies, and any combination thereof.

22. The system of claim 10 in which said electromagnetic energy is provided as light in a form selected from the group consisting of: non-coherent visible light, non-coherent infrared (IR) light, non-coherent ultraviolet (UV) light, coherent visible light, coherent infrared (IR) light, coherent ultraviolet (UV) light, and any combination thereof.

23. The system of claim 10 further comprising at least one display in operable communication with said processor.

24. The system of claim 10 further comprising at least one source of electromagnetic energy.

25. A system that determines the 3-D configuration of obscured parts of structure in motion and compares it to an expected 3-D configuration of said structure, comprising:

at least one device for directing electromagnetic energy in a pre-specified form to said structure,

wherein said structure is moved over said at least one device while maintaining physical separation therefrom, and

wherein said device enhances the contrast of said electromagnetic energy impinging on said structure;

at least one collector for acquiring, at a pre-specified sampling rate, electromagnetic energy reflected from said structure and providing said acquired electromagnetic energy as output;

at least one processor, having an input and an output, in operable communication with said at least one collector for manipulating said output of said at least one collector;

at least one database, stored so as to be accessible from at least said at least one processor, containing at least one configuration of at least one said expected structure; and

at least one controller that facilitates storing, manipulating, and reporting said output of said processor, and comparing at least one of said at least one configurations with said output,

wherein at least part of said system is embedded in or below a surface over which said structure moves.

26. A system that facilitates the conduct of large scale 3-D modeling of the surface of structure in motion, comprising:

at least one device for directing electromagnetic energy in a pre-specified form to said structure,

wherein said structure is moved over said at least one device while maintaining physical separation therefrom, and

wherein said device enhances the contrast of said electromagnetic energy impinging on said structure;

at least one collector for acquiring electromagnetic energy reflected from said structure and providing said acquired electromagnetic energy as output;

at least one processor, having an input and an output, in operable communication with said at least one collector for manipulating said output of said at least one collector; and

at least one controller that facilitates storing, manipulating, and reporting said output of said processor,

wherein at least part of said system is embedded on or in a surface over which said structure moves.